

The Future of NFIQ

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March 1, 2010

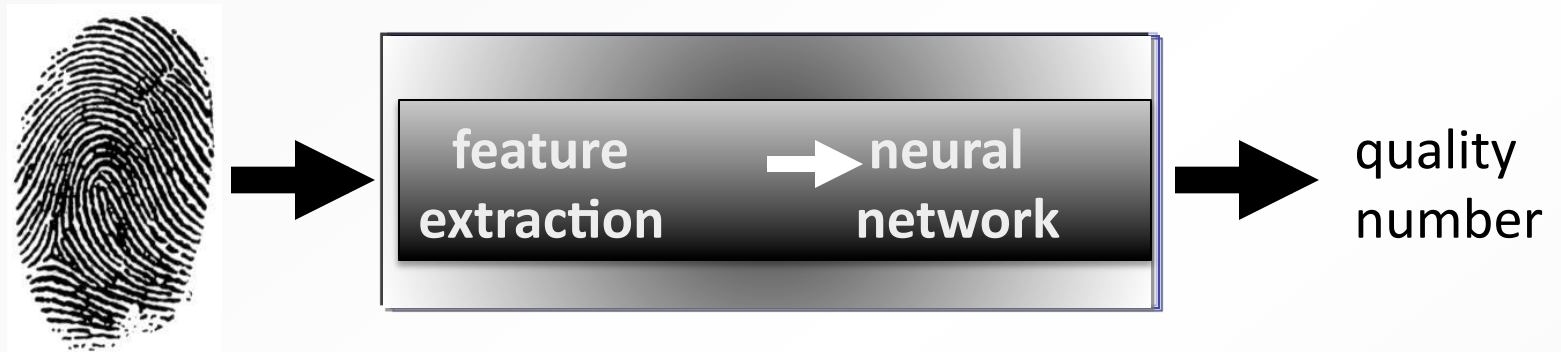
Agenda

- ÷ Welcome
 - Elham Tabassi
- ÷ NFIQ:: past, present, future
 - Elham Tabassi
- ÷ Retraining NFIQ based on BioDEV data
 - Markus Nuppeney (BSI)
- ÷ Break
- ÷ Discussion
 - All
- ÷ Wrap up
 - firm ideas on way forward

NIST fingerprint image quality

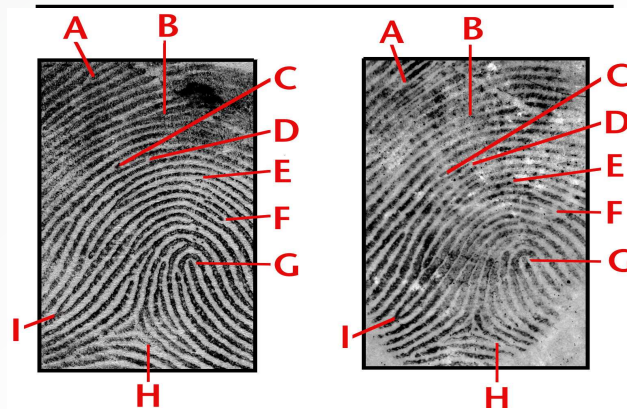
- NIST developed NFIQ in 2004
 - ÷ Open source
- Key innovation: quality as a rank statistic for performance
- NFIQ is a machine learning algorithm
 - ÷ Exploratory variables: image properties (minutiae, ridge density and clarity)
 - ÷ Response variable: separation of genuine and impostor comparison

NFIQ

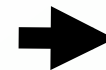
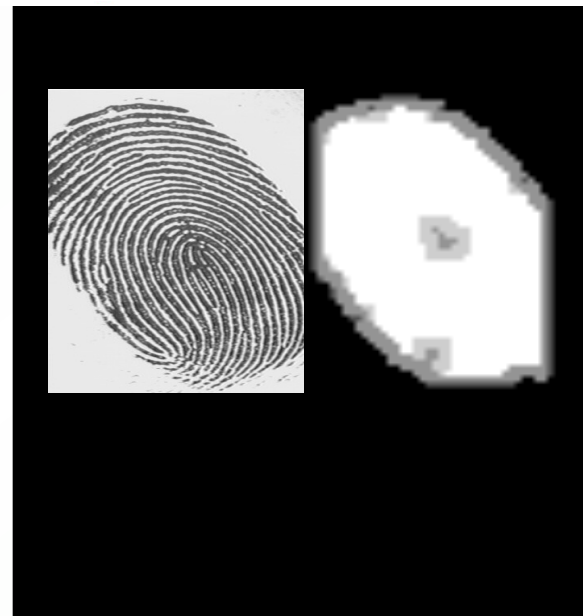


- **feature extraction:** computes appropriate signal or image fidelity characteristics and results in an 11-dimensional feature vector.
- **neural network:** classifies feature vectors into five classes of quality based on various quantiles of the normalized match score distribution.
- **quality number:** an integer value between 1 (highest) and 5 (poorest).

NFIQ – feature vector



gray scale
fingerprint
image



- 1 total # of minutia
- 2 #of min. with $q \geq .5$
- 3 #of min. with $q \geq .6$
- 4 #of min. with $q \geq .7$
- 5 #of min. with $q \geq .8$
- 6 #of min. with $q \geq .9$

- 7 size of foreground
- 8 quality zone 1
- 9 quality zone 2
- 10 quality zone 3
- 11 quality zone 4

NIST Minutiae detector (mindtct of NBIS distribution)
has been used for feature extraction.

NFIQ – training

11dimensional
feature vector



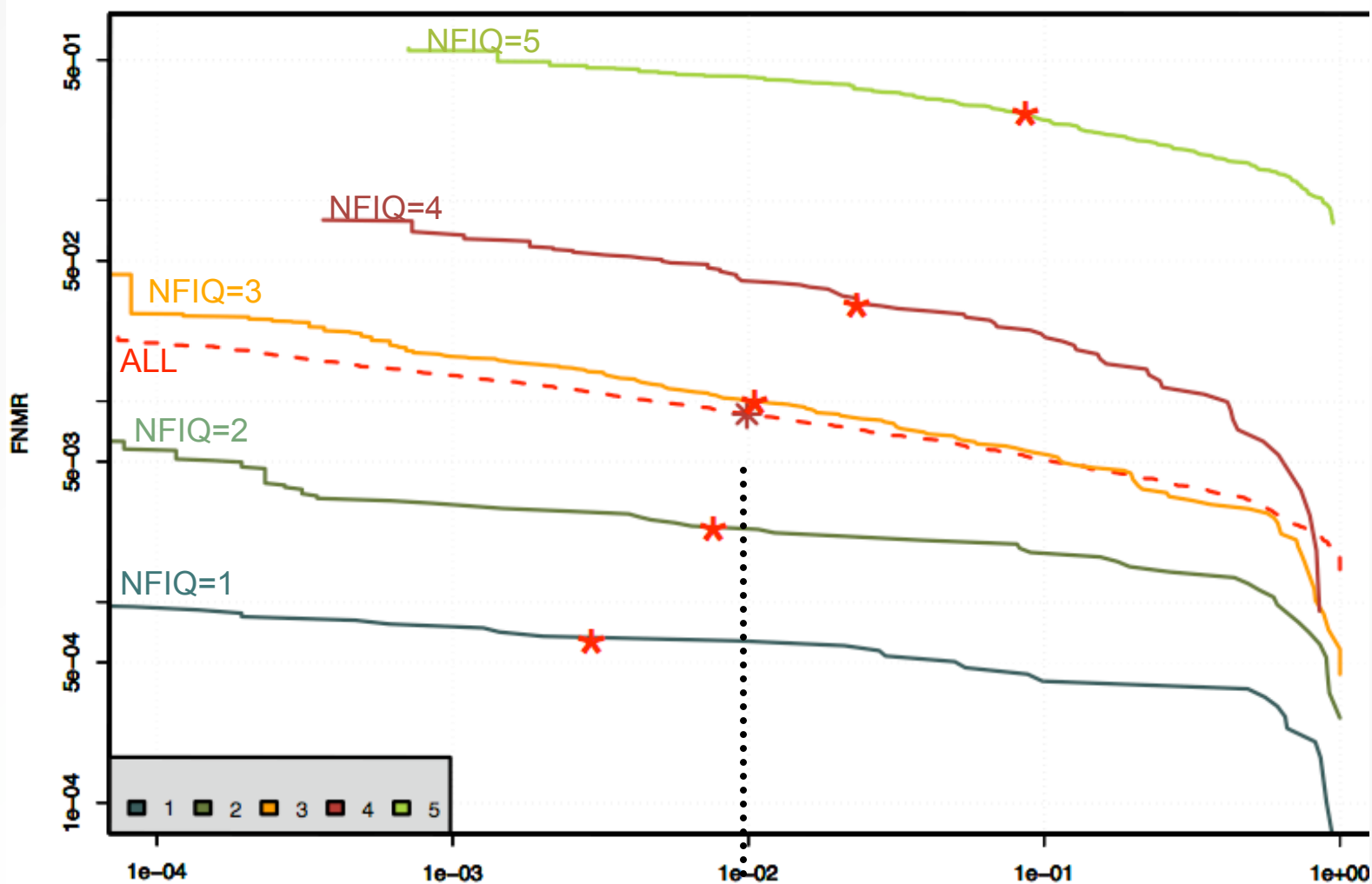
training: 3900
images of flat
index fingers and
thumbs

A full similarity
matrix of the
training set is
needed to
compute the
output class of
neural network.



quality number
{1,2,3,4,5}
1 is the best and
5 is the poorest

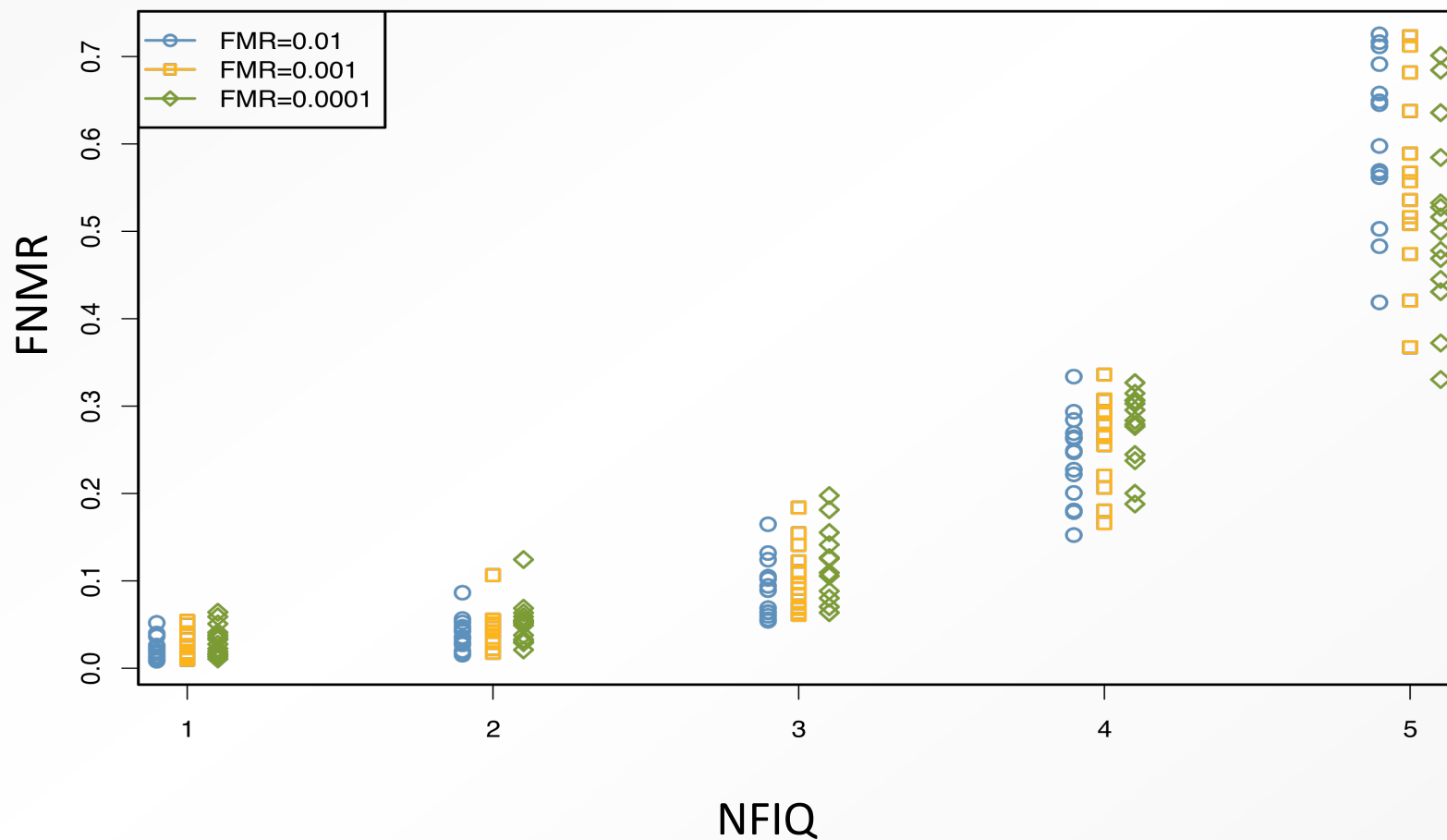
Quality: rank statistic for performance



NFIQ::(fmr,fnmr) at fixed threshold

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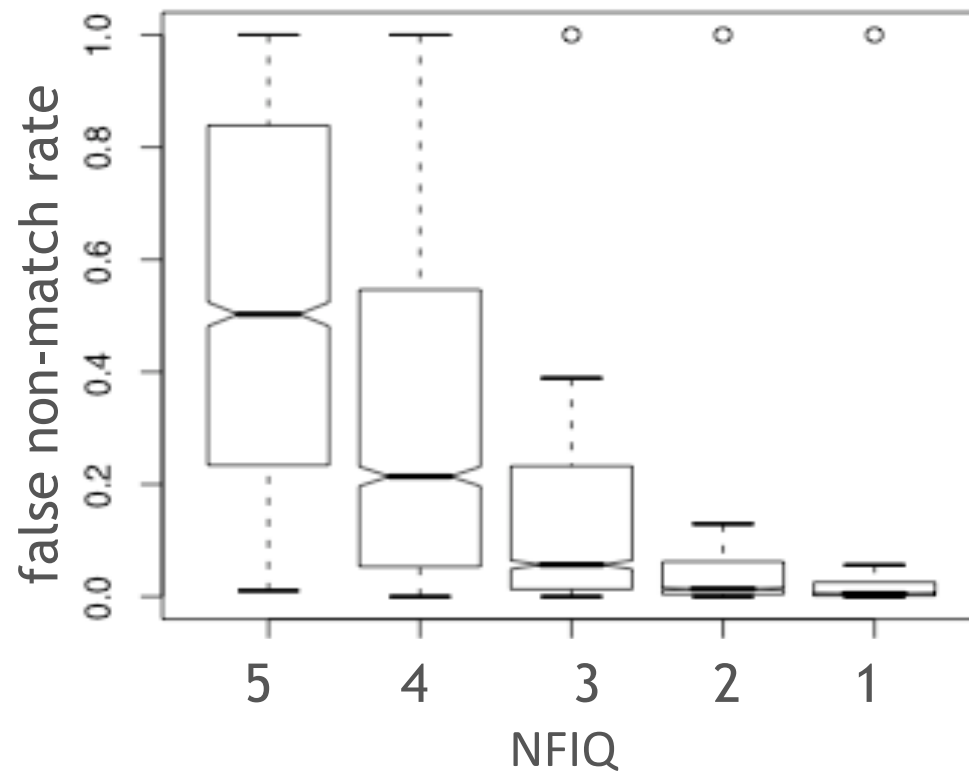
Dependence on matcher



Each point corresponds to one algorithm.

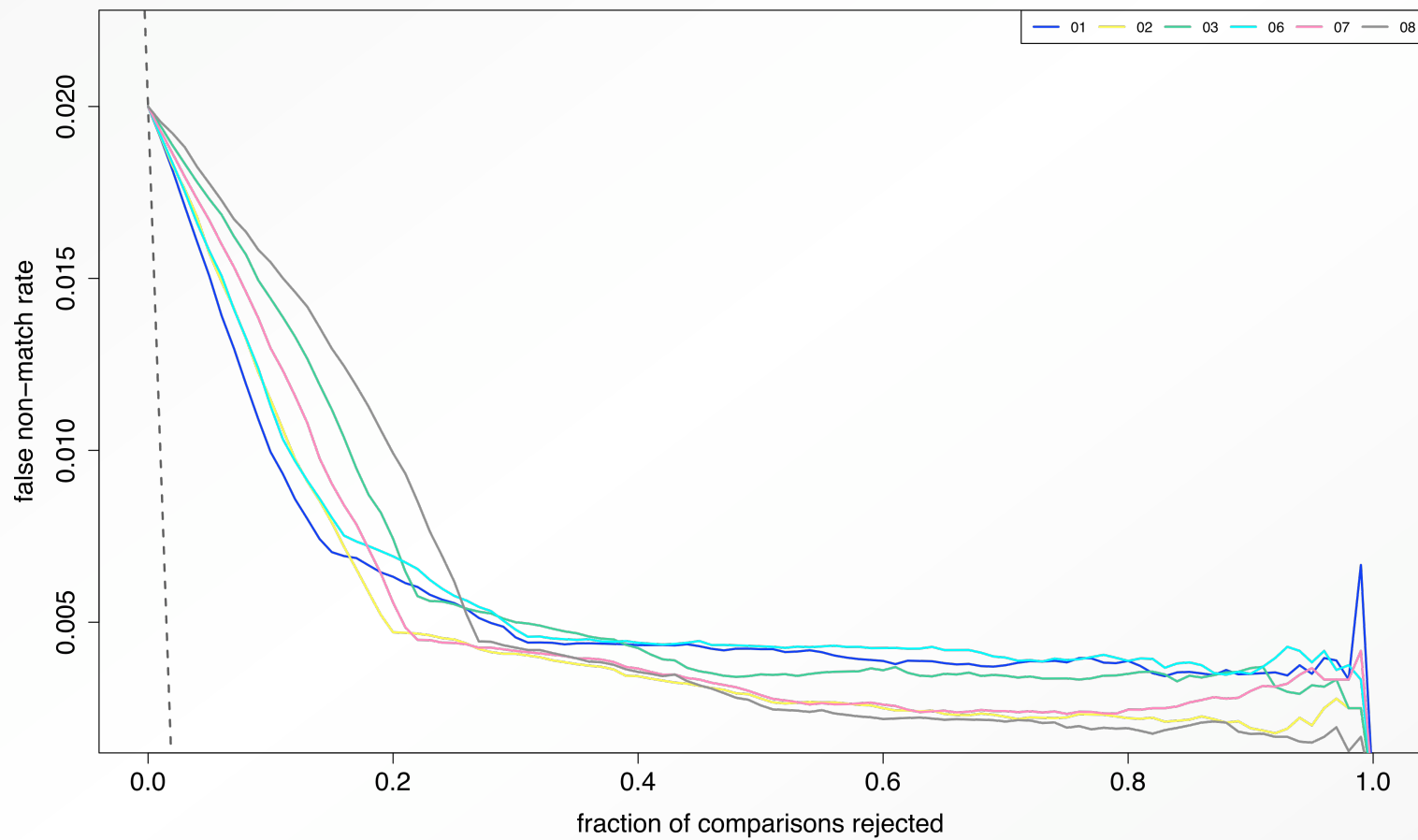
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How many levels?

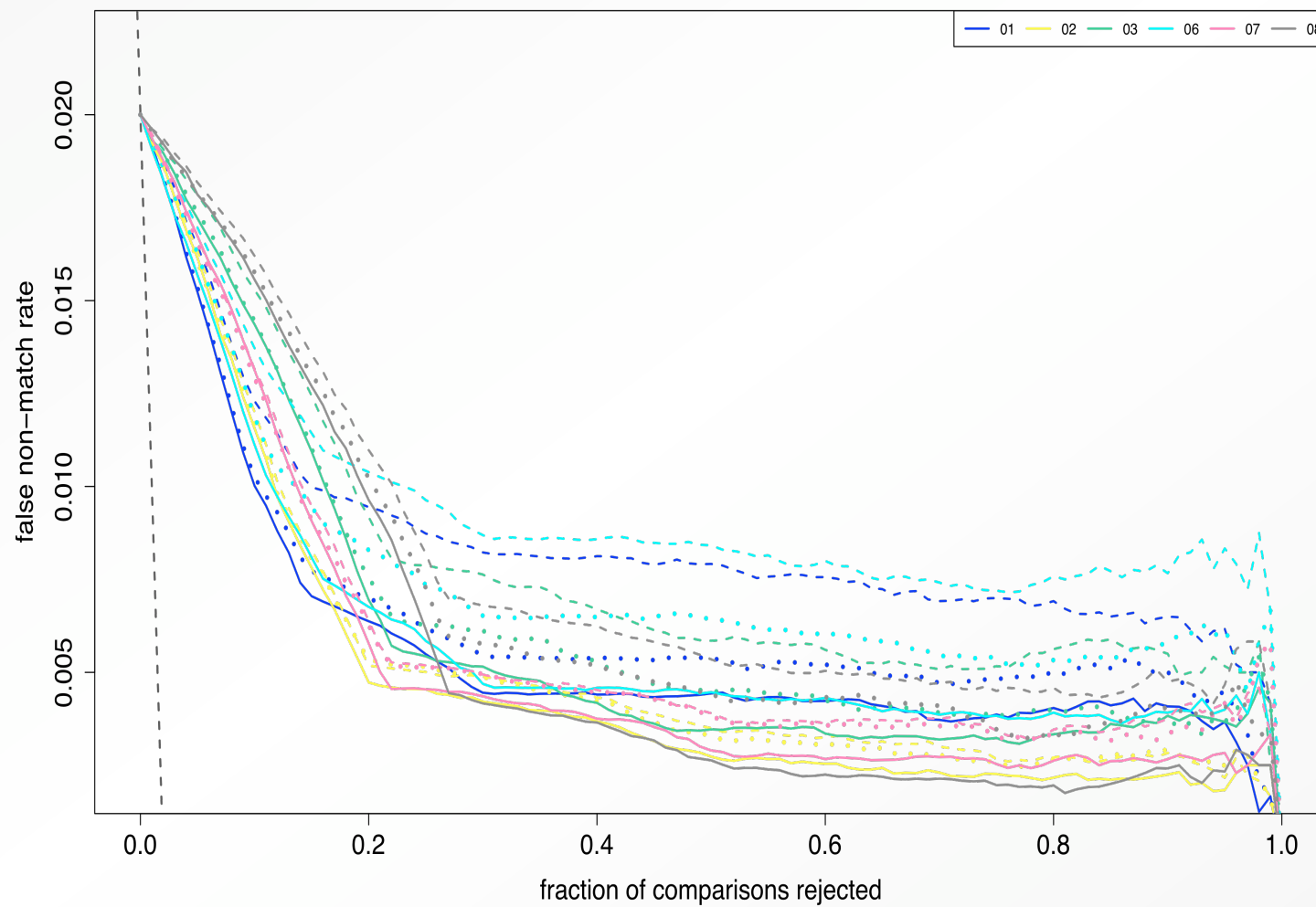


Statistically different level of performance

NFIQ rolled impressions -1



NFIQ rolled impressions -2



NFIQ – test of time

+

- ÷ Novel definition of biometric quality
 - performance related
 - accepted by the community
- ÷ Interoperability
 - uniform interpretation
 - tuned to a class of matcher
- ÷ Open source
- ÷ Extensively examined
 - by NIST and others
 - tools for quality summarization, slap, ...

–

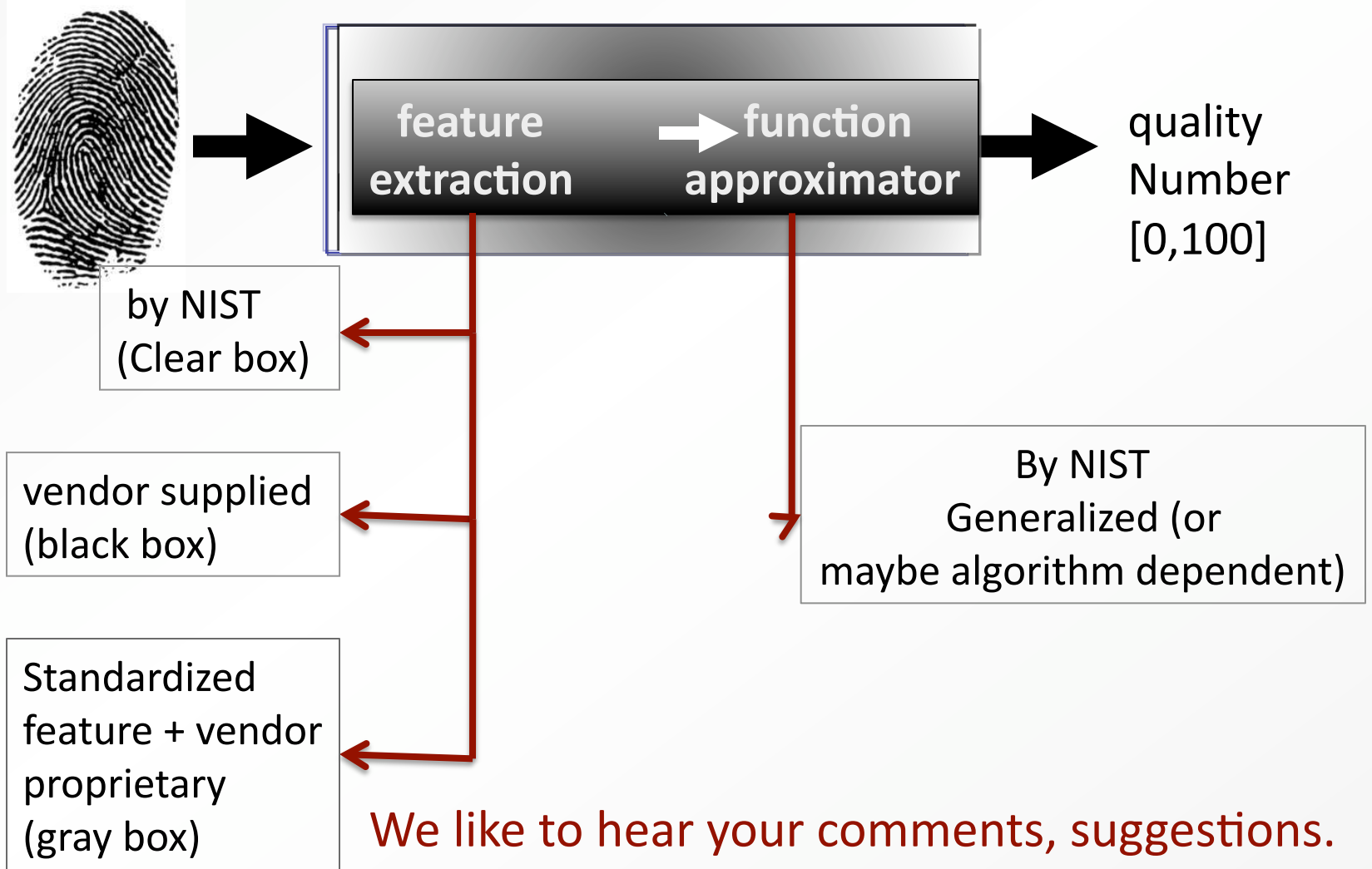
- ÷ Aging
 - recognition technology has advanced since 2004.
 - feature vector could be improved
- ÷ Efficiency
 - ~300 msec per image - not fast enough for real time
 - takes 4 times for 4-finger slap
- ÷ Not enough levels
 - Still statistically significant
- ÷ Not enough NFIQ 4

Options for NFIQ 2.0

- ÷ Do nothing!
- ÷ Incremental updates to NFIQ towards NFIQ 2.0
 - An improved NFIQ, generalized vanilla flavor
 - Improve feature extraction, training data, machine learning algorithm
 - done by NIST – open source
 - No ability to customize it to a particular application
 - Limited collaboration with industry
- ÷ Modular NFIQ 2.0
 - Plug-and-play feature vector
 - Improves efficiency in field operations
 - NIST does the training using its large sets of data
 - Generalized or specialized to a particular comparison algorithm
 - Feedback to vendors
 - Expands the marketplace of interoperable products
 - Calibrated quality in standardized range [0,100]

We like to hear your comments, suggestions.

Modular NFIQ 2.0



We like to hear your comments, suggestions.

<http://www.itl.nist.gov/iad/894.03/quality/>

<http://www.itl.nist.gov/iad/894.03/nigos/>

DISCUSSION

Q1. dedicated or generalized quality?

- ▣ generalized, matchers/extractors may change.
- ▣ dedicated – the deployed matcher / extractor is all that is important.
- ▣ both – each had its own utility.
- ▣ I don't care.

Q2. NFIQ 2.0 or not?

- ☐ Not – never liked NFIQ anyhow!
- ☐ NFIQ 1.0 was OK – but no need for NFIQ 2.0.
- ☑ Yes – it is timely.
- ☑ Abstain.

Q3. modular NFIQ 2.0?

☐ makes sense

☐ bad idea

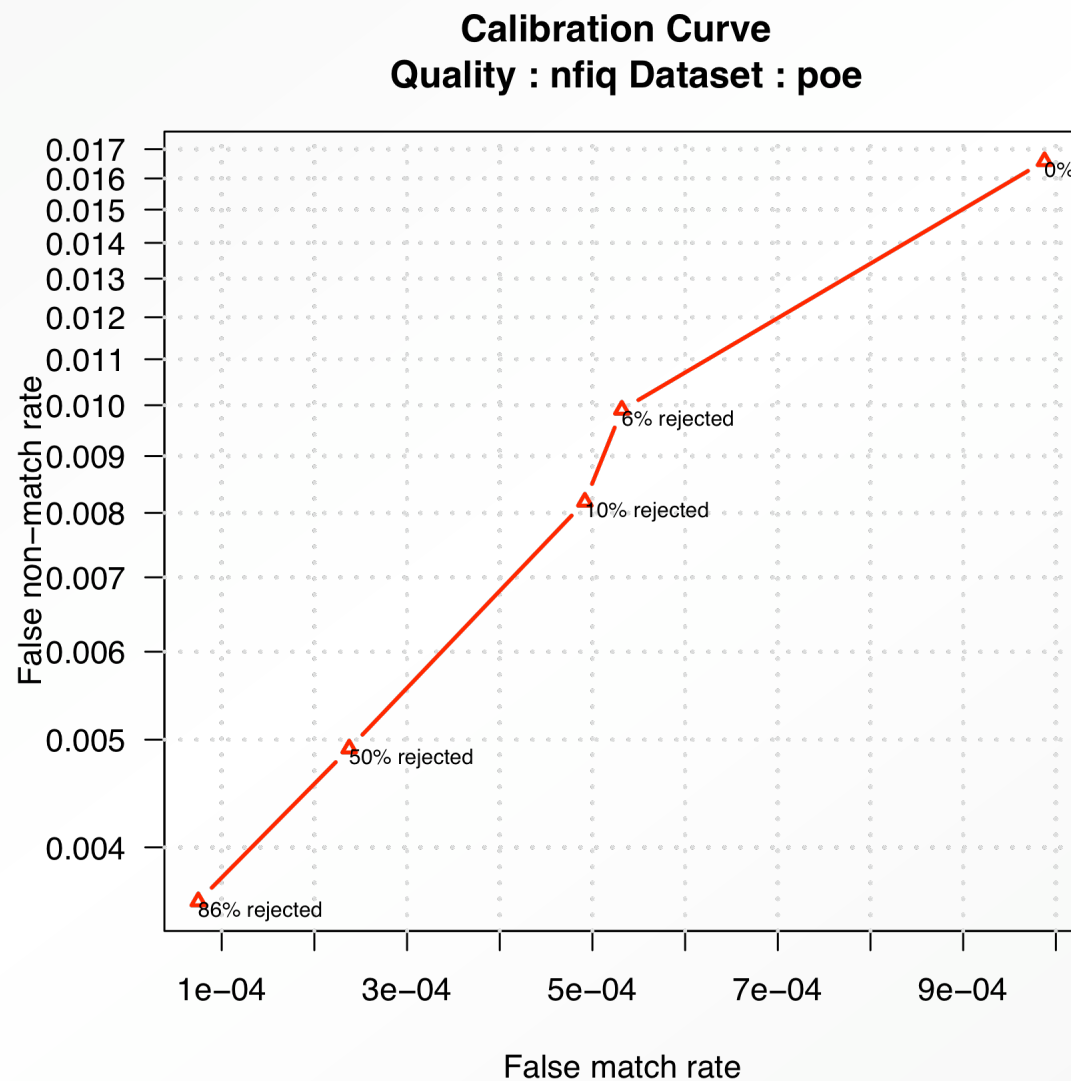
☐ complicated

☐ don't care

Q4. the most reasonable option is ...

- ☐ option 1 - do nothing
- ☐ option 2 – vanilla flavor, generalized, open source NFIQ 2.0
- ☐ option 3 – modular NFIQ
- ☐ none of the above
- ☐ don't care

Calibration Curve: Error vs reject : NFIQ



February 25, 2010

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NFIQ rolled impressions - 3

